PB-217 478

QUARTERLY PROGRESS REPORT, JULY 1-SEPTEMBER 30, 1969

Federal Water Pollution Control Administration
Corvallis, Oregon

October 1969

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 217 478

QUARTERLY PROGRESS REPORT

PACIFIC NORTHWEST WATER LABORATORY CORVALLIS, OREGON

JULY 1–SEPTEMBER 30, 1969

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. Department of Commerce
Springfield VA 22151

FEDERAL WATER POLLUTION
CONTROL ADMINISTRATION
NORTHWEST REGION

CLEAN WATER

48

PACIFIC NORTHWEST WATER LABORATORY

QUARTERLY REPORT

July 1 through September 30, 1969

United States Department of the Interior
Federal Water Pollution Control Administration
Northwest Region, Corvallis, Oregon

October 1969

I

CONTENTS

	Page
NATIONAL THERMAL POLLUTION RESEARCH PROGRAM	1
NATIONAL COASTAL POLLUTION RESEARCH PROGRAM	8
NATIONAL EUTROPHICATION RESEARCH PROGRAM	14
Physiological Control Branch	15
Ecological Control Branch	20
WASTE TREATMENT RESEARCH AND TECHNOLOGY PROGRAM	25
Paper and Allied Products Research Branch	25
Food Waste Research Branch	28
Regional Research Studies	35
BIOLOGICAL EFFECTS RESEARCH PROGRAM	38
CONSOLIDATED LABORATORY SERVICES PROGRAM	42
TRAINING AND MANPOWER DEVELOPMENT	45

NATIONAL THERMAL POLLUTION RESEARCH PROGRAM

910101/1613

Status of Projects and Significant Accomplishments

Consultation and Advisory Services

A staff paper, "Research and Development in Systems for Electric Power Generation," was transmitted to Headquarters August 20, as requested by the Commissioner on his visit here July 26.

NTPRP also supplied the Commissioner with comments on Mr. George Rhame's suggestions on closed-cycle gas turbine generation. Mr. Rhame is State Sanitary Engineer, South Carolina.

In August, materials relative to "Review of permit applications and siting studies for thermal electric power plants," were furnished the Northeast Region.

A staff paper on "Economic Aspects of Thermal Pollution Control in the Electric Power Industry" was prepared at the request of the Ohio Basin Region for presentation at a meeting with ORSANCO. A longer version of the same paper has been reviewed and submitted to the Regional Office for clearance as a working paper.

An inventory of "Status of Beneficial Use of Waste Heat in the U.S. and in Europe" was sent on September 2 to the Commissioner per request.

Sources of Heat Input to Water

Starting on July 21 and continuing through August 8, a research study was conducted on the banks of the Little Deschutes River, near

La Pine, Oregon, on the Cameron Cliff Ranch. The study focused its attention on two separate items: (1) the loss of heat energy from rivers due to evaporation, and (2) the use of covered ponds as devices to cool heated water. The surface of the study area of the Little Deschutes River was based on aerial photos made August 1.

Preliminary calculations have shown that the use of cooling ponds which are covered (wholly or partially) by a material that will prevent the entrance of incoming solar radiation may provide a means of cooling without excessive evaporation losses. Three ponds, each 8 ft. in diameter, were used. Two of the ponds were heated electrically to simulate the waste heat from a 1000 megawatt nuclear power plant, and the third pond was used as an unheated control. One of the heated ponds was covered with a white, plastic material to retard evaporation and inhibit the entrance of incoming radiation. The amount of heat added to this pond was scaled to simulate a 4000 acre prototype pond. The second heated pond was left uncovered, and the heat added to it was proportioned to a 2000 acre prototype pond. All three ponds were mixed to ensure uniform temperatures. Weather data useful for both study objectives were taken twenty-four hours a day and recorded automatically. Information on wind, air temperature, pond temperature, humidity, and long- and short-wave radiation was collected in this manner. In addition, periodic measurements of pond evaporation were made.

Preliminary evaluation of the data shows reasonable comparison between computed and measured values, however, further refinements are necessary in both the data reduction and computational techniques.

The successful completion of the analysis of information generated by the study will enable engineers to (1) make better predictions of river temperatures for planning future power plant locations, and (2) design cooling ponds which will prevent heated water from polluting streams and lakes but will not evaporate large quantities of valuable water.

Effects of Heat Management on the Environment

"Sampling Methods for Establishment of Biological Baseline at Sites of Potential Thermal Pollution," a paper by Dr. Ronald Garton and Dr. Ralph Harkins, has been completed and is in the process of being reviewed.

Studies were begun in July on effects of a floating hot water lens on emergence of aquatic insects.

Effects of Temperature on Fresh and Marine Fish Species

See Biological Effects Research Program Report, page 38.

Engineering and Cost Aspects of Heat Dissipation

The computer program for a mathematical model for natural draft cooling tower is being finalized.

Design Criteria for Heat Discharge Outfalls

Decision was made to renovate the Carpenter Shop for use in research in fluid dynamics.

General

Mr. Rainwater participated as a speaker August 27 at the 8th Argonne National Laboratory-AUA Faculty-Student Conference at Argonne, Illinois.

NTPRP has formalized an orientation talk on thermal pollution for use in training courses of FWPCA, etc.

Mr. Rainwater attended a meeting of the Interdepartmental Task Force Charged with Identification of Power Plant Siting R & D, Knoxville, Tennessee, September 11, 12.

A meeting was held at the National Water Quality Laboratory in Duluth on September 17 and 18 to review research activities and plans re thermal pollution. Those participating were staff of NWQL involved in temperature requirements, Dr. J. F. Allen, Acting Assistant Director for Biological Sciences, FWPCA, and Messrs Rainwater, Garton and Bouck, PNWL.

Grants and Contracts

Assistance was provided Headquarters and the Northwest Regional Office relative to a research proposal on "Physical and Socio-Economic Evaluation of Site Alternatives for Nuclear Power." Mr. Rainwater met twice with principals of the proposer and representatives of the Northwest Region to discuss FWPCA interest in this area.

On September 30, Mr. Rainwater and Mr. Christianson attended a meeting in the Regional Office with representatives from State of Washington, AEC, utilities and Battelle Northwest concerning possible

cooperative research on the beneficial use of power plant condenser effluent for agricultural purposes east of Cascades.

Technical reviews of formal proposals for research grants, demonstration grants and contracts were provided for the following subject matters:

1. Temperature Rise Resulting from Nuclear Reactor Cooling.
2. A Method of Claiming Useful Work from Heat Wasted in Large Power Plants.
3. The Applicability of Weather Station Data for Water Surface Energy Budget Calculations.
4. Subsurface Irrigation for Improved Water Use Efficiency and Heat Balance of Soils.
5. Experimental Investigation of Spray System for Atmospheric Heat Dissipation.
6. Thermal Effects of Three Species of Columbia River Trichoptera.
7. Thermal Pollution Reduction, Fossil-Fuel-Fired Superheaters for Nuclear Power Plants.
8. Analysis of Engineering Alternatives for Environmental Protection from Thermal Discharges.
9. Non-Evaporative Cooling Towers.
10. Combined Waste/Heat Treatment.
11. Suggestion on Closed-Cycle Gas Turbine Generation.
12. An Evaluation of the Effects of a Heated Water Discharge, Lake Sinclair, Georgia.

13. An Economic Analysis of Thermal Pollution Abatement Costs in the Electric Power Industry.
14. Thermal Plume Dispersion.
15. Temperature Distribution as a Result of Heat Addition in a Water Reservoir.
16. Diffusion of Thermally Buoyant Water Jets into a Moving Water Stream.
17. Possible Control of Thermal Pollution by Biological Means.

Reports and Papers

Dr. Garton presented a talk on the National Thermal Pollution Research Program to personnel in the South Central Regional Office. He also attended the American Fisheries Society 99th Annual Meeting in New Orleans, Louisiana, September 10-13.

A report, "Survey of Large-Scale Heat Rejection Equipment," prepared as part of FWPCA's Contract with Dynatech R/D Company on the subject of "A Survey and Economic Analysis of Alternate Methods for Cooling Condenser Discharge Water in Thermal Power Plants," was received and distributed to all Regions and to individuals in Headquarters.

Plans for the Second Quarter, FY 1970

The experimental phase of the cooperative research with USGS will be undertaken at Colorado State University, Ft. Collins, Colorado, and completed as planned if sufficient program funds are available. Drafts of two research papers will be written for possible publication in professional journals.

Analysis of data from Little Deschutes field study.

The paper "Sampling Methods for Establishment of Biological Baseline at Sites of Potential Thermal Pollution," will be reviewed and distributed during the second quarter.

Distribution of paper, "Economic Aspects of Thermal Pollution Control in the Electric Power Industry," will also be made.

NATIONAL COASTAL POLLUTION RESEARCH PROGRAM

910101/1607

Status of Projects and Significant Accomplishments

Reaeration

Atmospheric reaeration rates were measured on the Yaquina estuary about 4-6 miles above Toledo, Oregon, under varying tidal, salinity, and temperature conditions. Rates observed are similar in magnitude to rates reported in literature.

The proposed study of atmospheric reaeration rates on Galveston Bay was indefinitely postponed due to budget limitations.

Working drawings for an in situ radioactivity counter are being developed.

Analysis of Dredge Spoils

The benthic respirometer was employed in the Duwamish River estuary to compare with the results obtained previously from Bellingham Bay. Samples of the bottom were taken for element analysis and oxygen uptake measurements at the laboratory

NAS-NAE State of the Art Report

Working groups of the National Academy of Science Committee on Oceanography and the National Academy of Engineering Committee on Oceanographic Engineering met at Jackson Hole, Wyoming, July 7-12, to review drafts of working papers for the report on Management of Wastes in the Coastal Environment. D. J. Baumgartner, M. H. Feldman, and

R. J. Callaway represented the National Coastal Pollution Research Program. A summary of information obtained from FWPCA Pollution Surveillance Branch and from each coastal Regional Office concerning projects now underway and problems requiring attention in the near future was submitted to a steering committee for their information and utilization in assembling a final report. The assembled recommendations and individual reports on physical, chemical and biological aspects will be compiled into the final report by the steering committee.

Kraft Mill Outfall Plumes

Kraft mill outfall wastes are being traced by means of a fluorescence procedure. Samples obtained by the Oregon State University Civil Engineering Department from the effluent plume of a paperboard mill at Eureka, California, and from the mill pond piping, were analyzed and compared with spectra obtained from other kraft process wastes.

Columbia River Estuary Temperature Model

Schematization of the lower 28 miles of the Columbia was completed in July. This section constitutes the 'estuary' proper. In August the hydraulic portion and input data on this program were turned over to the Regional Office for conversion to the IBM 360 system. Work continued on the testing of the heat budget section.

Using a one-hour time step, the complete temperature model was run in September on the simplified estuary system (five junctions, four

channels). Progress was hampered somewhat during the month because of breakdowns originating at the computer center. Work continues on a user's manual.

Estuarine Diffusion of Pollutants

A 188-page report was received from Tracor, Austin, Texas, covering the proceedings of the June 24 Annapolis conference for preparation of a state of the art report on estuarine water quality modeling. Individual chapters are now in preparation, to be reviewed at the next technical meeting, tentatively scheduled for mid-November. A five-week extension was granted to extend the fall conference on estuary modeling to mid-November and the delivery of the final report to January 1, 1970, due to the fact that some chapter authors have not been able to meet the original deadline for their first drafts.

Ocean Outfalls

State of the art report number one has been reviewed and is in the final stages of revision. This report covers the basic theoretical development of relationships necessary for the design of an outfall system. Hydraulic model studies are continuing.

Design of Barge Disposal Systems

The state of the art report on barge waste disposal has reached the stage where an outline and abstracts of a large number of pertinent articles have been completed.

Hydraulic model studies and several trial experiments have been completed. Use of the videotape system was investigated and appears to have considerable merit in recording data from these experiments. Slug release mechanisms have been constructed for future experiments that will also allow a determination of the effects of shape on the mixing and dispersion of slug releases of waste materials.

Equipment and Instrumentation

The Request for Proposal for development and demonstration of equipment and methodology for tracing solids discharged to the marine environment has been completed and an advertisement for bidder qualifications has been placed in the Commerce Business Daily.

Development of in situ conductivity probes for use in hydraulic model studies is being delayed by construction of conductivity probes and purchase of carrier preamplifier and power supply. These instruments will not be available until February 1970 at the earliest.

Bids were solicited for construction of a circular hydraulic model tank to supplement the present facilities for simulation studies on waste discharge processes and mixing zones.

Grants and Contracts

Technical reviews were provided on applications and proposals for research grants and contracts related to the following subjects:

1. Baseline Water Quality Study of the Alaskan Arctic Estuarine Environment.
2. Thermal Plume Dispersion.

3. Estuarine Ecology Research.
4. Physical Factors Affecting Oregon Coastal Pollution.
5. Abundance and Distribution of Mercury in Watersheds and Estuaries of the Gulf of Mexico.
6. Marine Waste Disposal and Sea Urchin Ecology.
7. Use of Carbon to Define Water Quality in Galveston Bay Study.
8. Studies on the Chemistry and Microbiology of Pollution in Selected Marine Areas of Southern Puerto Rico.
9. Correlated Studies of Vancouver Lake - Hydraulic Model Study.
10. Correlated Studies of Vancouver Lake - Water Quality Prediction Study.
11. A Computer Simulation Model or Systems Approach to Equilibrium Compositions of Chemical Reactions.
12. Containment and Collection of Oil on the Open Sea.
13. Engineering Study of Design Criteria for Floating Booms.

Areas of Concern

Extensive delays in securing renewals for extramural research projects have caused some strained relationships with our university colleagues, and possibly with our Headquarters program representative. Improved methods for review and approval of initial and renewal applications need to be developed.

Plans for Second Quarter, FY 1970

It is planned to continue reaeration rate studies and to work on in situ radioactive tracer experimental equipment.

The user's manual for the Columbia River model will be completed and distributed for review.

The second conference on the state of the art report for estuary modeling will be held and the final report from TRACOR will be reviewed.

Continue work on ocean outfalls, design of barge disposal systems, and equipment and instrumentation as discussed above.

NATIONAL EUTROPHICATION RESEARCH PROGRAM

910101/1601 and 910102/1601

General

Dr. Bartsch participated as a witness on eutrophication in the reconvened Lake Superior Enforcement Conference held in Duluth, Minnesota, September 30 and October 1.

Mr Maloney presented a paper entitled, "Research to Save America's Lakes," before the 66th National Meeting of the American Institute of Chemical Engineers in Portland, Oregon, on August 26.

On August 6 and 7 Dr Bartsch met with representatives of the Southeast Region, the Florida State Air and Water Pollution Control Commission, and the Florida State Game and Fresh Water Fish Commission relative to eutrophication problems in Lake Apopka.

On August 18 Dr Bartsch presented a talk "The Technology Available and Need to Control Eutrophication" at the Save the Lakes Symposium, held in Detroit Lakes, Minnesota.

On August 26 Dr. Bartsch presented the paper "Accelereated Eutrophication of Lakes--Ecological Response to Human Activities" at the Symposium on Ecological and Evolutionary Implications of Environmental Pollution at the XI International Botanical Congress held in Seattle, Washington.

A R Gahler attended the National Meeting of the American Chemical Society in New York in September and conferred with NERP grantees.

On September 9 Dr. Bartsch presented a talk "Let's Fight Eutrophication" at the Annual South Dakota Water and Wastewater Conference held in Sioux Falls.

PHYSIOLOGICAL CONTROL BRANCH

Status of Projects and Significant Accomplishments

Algal Assay Procedures Section

The evaluation of Selenastrum capricornutum as a test organism in the batch and continuous-flow test of the Provisional Algal Assay Procedure was continued. A series of tests, employing samples from three lakes in Oregon, were conducted. The following table shows the basic nutritional characteristics of the test waters and the seven-day algal growth responses.

Source	mg/ℓ Tot. C	mg/ℓ Tot. N	mg/ℓ Tot. P	pH	N/P Ratio	7-day growth Response cells/ml S. capricornutum
Clear Lake	5.0	0.3	0.08	6.5	3.8/1	19,000
Triangle Lake	5.0	0.2	0.01	6.6	20/1	8,000
Woahink Lake	<1.0	0.8	<0.01	6.2	80/1	2,500
PAAP Medium	7.0	13.4	0.56	7.0	24/1	2,500,000

In general, the algal growth response correlates well with the nutrient content of the water. In Triangle Lake, algal growth appears to be phosphorus limited, and in the case of Woahink Lake, both phosphorus and carbon appear to be limiting.

A series of carbon-14 "bottle test" algal assays was also conducted in conjunction with the Cline's Pond study and the Shagawa Lake project.

Assays were conducted on samples from the aerated (destratified) and non aerated portions of Cline's Pond. Assays were also conducted on Burntside River water, the main tributary to Shagawa Lake; on Shagawa Lake water; and on secondary sewage effluent. Phosphorus spikes were made to both Burntside River water and Shagawa Lake water.

When samples of water from the aerated side of Cline's Pond were subjected to the static PAAP test, a substantially greater amount of algal growth resulted than when samples from the non aerated side were subjected to the same test. The amount of algal growth appears to be directly correlated with the phosphorus present. It is interesting to note that in the natural environment, the opposite was true with respect to algal growth; that is, the non aerated side supported a heavy growth of algae while there was no apparent algal growth in the aerated portion. Under natural conditions the heavy algal growth in the non aerated portion depleted the water of its phosphorus, and this was apparent in the chemical analysis and laboratory assay.

The results also suggest that both Burntside River and Shagawa Lake waters are phosphorus-limiting for algal growth. While neither of these waters supported good algal growth, spiking with 0.02 mg P/ℓ increased algal growth significantly. Phosphorus additions greater than 0.02 mg/ℓ did not have any additive effect on promoting algal growth.

Eight continuous-flow chemostats were set up to compare the growth response of S. capricornutum with and without aeration and ventilation under both continuous lighting and a 12-hour photoperiod. All cultures were maintained in a steady-state for over 30 days. The highest level

of growth was obtained in the chemostats being aerated from the bottom of the reactor and on a 12-hour photoperiod. In all chemostats the pH rose rapidly with an increase in algal growth.

The effects of ventilation and aeration upon the growth of S. capricornutum were also investigated under carbon-14 "bottle test" conditions employing natural lake waters and PAAP medium. Results suggest that neither ventilation nor aeration has little effect upon algal growth in natural lake waters (carbon/nitrogen ratio >24), but dramatically increased growth response in PAAP medium (carbon/nitrogen ratio = 0.5). The results obtained in these experiments and those obtained in the continuous-flow experiments indicate that carbon is limiting for algal growth in the PAAP medium.

Physiology Section

Studies to determine the optimum concentration of nitrogen (as nitrate) for the growth of S. capricornutum were continued. The results show that the optimum nitrogen concentration is 1.6 mg N/ℓ and the optimum N:P ratio is 16:1 by weight.

Experiments were made to evaluate the use of Tris buffer (tris (hydroxymethyl)-aminomethane) to maintain pH during algal growth in the PAAP culture medium. The optimum concentration for pH control was 0.01M Tris and Tris concentrations much above this were toxic to S. capricornutum. The medium buffered with 0.01M Tris maintained a pH of 7.5 ± 0.2 pH units during algal growth whereas the pH of

unbuffered medium increased to 10.4 after three to four days. When the alga was grown in a chemostat in unbuffered PAAP medium at a seven-day retention time, algal growth reached a concentration of 5×10^5 cells/ml after four days. As the pH reached 10.5 growth declined. When the pH was readjusted to 7.5 and 0.01M Tris buffer added, the cell concentration increased to 1.6×10^6 cells/ml in 24 hours with a pH increase to 8.0. The cell concentration finally reached a steady-state at 3×10^6 cells/ml with no further rise in pH.

Because of suspected aluminum toxicity to algae in connection with the tertiary treatment pilot plant at the Shagawa Lake project, a series of assays were made to determine the toxicity of aluminum to the blue-green alga, Anabaena flos-aquae. While 0.2 mg Al/ℓ was only slightly toxic, there was no algal growth above a concentration of 0.5 mg Al/ℓ.

Aquatic Plant Control Section

Bacterial cultures which have been isolated and had indicated some apparent anti-algal activity in preliminary assays have failed to display any significant algal control properties when assayed on a larger scale.

Grants and Contracts

Technical reviews of preproposals and proposals for research grants, demonstration grants, and contracts were provided for the following subjects:

1. Heterotrophic Nutrition of Fresh Water Plankton Algae.
2. Eutrophication Workshop, S.E.
3. Ecology and Physiology of Blue-Green Algae.
4. Contribution of Humic Acids from Land Drainage and Their Effects on Phytoplankton Growth.
5. Biological Effects of Heavy Metal Pollution.
6. Removal of Algal Nutrients by Activated Algae.
7. Development of Decision Criteria for Evaluating the Technological and Economic Effectiveness of Alternative Algal Bloom Management Methods.

Plans for the Second Quarter, FY 1970

Evaluation of the Provisional Algal Assay Procedure, emphasizing natural waters at various trophic levels, will be continued. Emphasis will be on evaluating the continuous-culture method as a means of assessing algal growth kinetics in comparison with the batch-culture technique.

Studies relating to the nutritional and environmental requirements of the PAAP test species as well as to other algal species will continue.

Cultures of the blue-green algal viruses LPP-1 and SM-1 have been received from the R. A. Taft Water Research Laboratory. Methodology relating to the use of phycoviruses to control blue-green algae will be developed at this laboratory; a program to screen phycoviruses for their ability to attack nuisance algae will be initiated when practical.

ECOLOGICAL CONTROL BRANCH

Status of Projects and Significant Accomplishments

Nutrient Control Section

After the mechanical difficulties encountered last quarter were resolved, aeration of the experimental section of Cline's Pond was resumed and continued uninterruptedly throughout July, August, and September. Little, if any, leakage past the plastic curtain was detected. Chemical and physical stratification were rapidly destroyed in the aerated section, which thereafter remained in a completely mixed condition. The non aerated control section remained stratified, with severe oxygen depletion in the deep water. A dense bloom of Anabaena occurred in this section, whereas blue-greens disappeared from the aerated portion of the pond. The aeration appears to have achieved considerable oxidation of the sedimentary organic layer, which has become much reduced in thickness.

Waldo Lake was sampled once each month. Physical-chemical measurements reveal a condition of extreme oligotrophy. For example, total solids are less than 5 mg/L, and conductivity less than 5 micro mhos. Secchi disc transparency is in excess of 30 meters. Bottom sediment samples were taken in August for analysis of interstitial water, and a detailed bathymetric survey was made in September.

Analysis of sediment and aquatic-weed samples from Sallie Lake, Minnesota, has continued, and chemical analysis of fish from that lake is being undertaken to obtain some estimate of nutrient removal through fish harvesting.

Sediment-Water Interchange Section

Laboratory and field work this quarter have emphasized nutrient inhibition and prevention of sediment-water interchange. Addition of Boliden aluminum sulfate pellets to lake water in aquaria brings about drastic reductions in phosphorus and algal growth. The resultant floc which forms on the sediment, however, supports dense growths of blue-greens. Similar results were described in last quarter's report.

One of the six experimental pools made by Plasti-Steel Corporation was delivered in August and installed in Upper Klamath Lake. These pools are made of reinforced PVC and have a capacity of 16,400 gallons. They are open at the bottom. Boliden aluminum sulfate pellets were added to the water in the installed pool at a rate of 50 mg/ℓ. No biological effects have been observed; coagulation of Aphanizomenon did not occur. Dissolved oxygen appeared to be partially depleted, however.

Characterization of Lake Erie sediments has continued, and a program of sediment studies is being developed in cooperation with the Shagawa Lake project.

Shagawa Lake Project

Algal growth stimulation experiments were carried out in 8, 100, and 150,000 gallon in-lake basins. In the two smaller basins, water from Burntside River (the major input to Shagawa Lake) was mixed with secondary sewage from the Ely municipal plant, and with Waterboy and

deionized effluent from the tertiary treatment pilot plant. Basins containing unaltered Burntside water and Shagawa Lake water served as controls. All basins were inoculated with Shagawa Lake phytoplankton. In all instances, concentrations of secondary effluent as small as 2% were found to strongly stimulate algal growth, whereas, no stimulation resulted from addition of effluents from the tertiary treatment pilot plant. In spiking experiments utilizing P, N, and P + N, stimulation was achieved only when both P and N were added to Burntside River water.

In the 150,000 gallon basins, Shagawa Lake water was mixed with various concentrations of secondary sewage, Waterboy, and deionized effluent. Secondary sewage at concentrations of 5 and 20% produced greatly increased algal standing crops.

Grants and Contracts

Reviews of preproposals and proposals for grants and contracts were provided for the following subjects:

1. Evaluation and Demonstration of Irrigation Methods and Practices to Reduce Contamination in Irrigation Waste Waters.
2. Development of a Eutrophication Control Program Utilizing Systems Analysis.
3. Phosphorus in Aquatic Ecosystems, Model Experiments.
4. Correlated Studies of Vancouver Lake - Water Quality Prediction Study.
5. Correlated Studies of Vancouver Lake - Hydraulic Model Study.

6. Eutrophic Lake Reclamation by Physical and Chemical Manipulations.
7. Comments on Review of Tocks Island Reservoir Project.
8. Data Requirements for Prediction of Eutrophication.
9. Proposal to Joint Task Force, Research on Natural Lakes and Impounding Reservoirs Directed Toward Gaining and Understanding of the Causes of Eutrophication, for Research Activities Committee of the Task Force Meeting on August 11, 1969.
10. Developing of an Ecologic Model for Eutrophying Streams and Estuarial Systems.
11. Development of Techniques for Predicting Eutrophication in Natural and Artificial Impoundments.
12. Upwelling and Nutrient Transport in Stratified Lakes and Reservoirs.
13. Water Quality Prediction Study and Hydraulic Model Study.
14. Nitrogen Release from Sediments of Reservoirs Experiencing Water Level Fluctuations.
15. Reversal of Eutrophication through Artificial Aeration of Lakes.
16. Water Quality and Circulation Studies Across Lake Michigan and Seasonal Factors Controlling Eutrophication, Part I: Development of Equipment
17. Biological Studies Relating to Water Quality in the Guadalupe River, Texas

Areas of Concern

Loss of intermittent employees will result in a cutback in research programs. Little progress was made in the effort to establish lake restoration demonstration programs. Lack of travel funds, resulting in inability to visit potential sites, has been a major block.

Plans for the Second Quarter, FY 1970

Field work on Cline's Pond and Waldo Lake will terminate in November. The rainfall collection-analysis program will become active. Laboratory work on uptake of nutrients by rooted aquatics and nutrient transport in stratified aquatic systems will be carried on. Completion of these studies is expected by the end of the fourth quarter. Several visits will be made to Upper Klamath Lake to obtain experimental samples. Analysis of sediments from Shagawa Lake will begin, and more samples from Lake Erie will be obtained.

Efforts will continue in the area of lake restoration programs. Detailed planning will be completed and possibly at least one trip to potential sites will be made.

WASTE TREATMENT RESEARCH AND TECHNOLOGY PROGRAM

PAPER AND ALLIED PRODUCTS RESEARCH BRANCH - 910101/1204

Status of Projects and Significant Accomplishments

Polymers in Waste Treatment

The laboratory phase of this project has been concluded and Mr. Tyo has been transferred to Consolidated Laboratory Services (CLS). The draft of the report, "Polymers in Primary Treatment," for this project has been reviewed and suggestions for rewrite returned to Mr. Tyo. Dependent on final results and availability of manpower, some field applications may eventually become possible.

Nutrients in Waste Treatment

We have continued laboratory and special investigation support of this project in cooperation with Crown-Zellerbach at Lebanon, Oregon. Dr. Willard devotes about one-half time to this pursuit. Mr. Drotts has recently been assigned to aid Dr. Willard in some of the biological investigations. The objective is to determine optimum nutrient levels for biological treatment of pulp mill waste.

Microsieve Applications to Pulp and Paper Wastes

The purchase of a pilot Beloit microsieve was concluded at end of FY 69 and delivery is expected soon. Delivery and backwash pumps are still required. If manpower is available, test work can be conducted at several pulp and paper mills in the vicinity of Corvallis to determine applicability of such equipment.

Characterization of Sludge Loads from Aerated Lagoons

Some small amount of work on this project has been completed at the Lebanon project. Earlier work loads on CLS restricted BOD work. This project should be enlarged to cover Springfield and Halsey. Laboratory manpower reductions will probably further reduce analytical capabilities for this work.

Grants and Contracts

Monitoring and review of research and demonstration grants and contracts continued to occupy the great majority of time in Paper and Allied Products Research Branch. All projects listed in last quarter's report are still active. Several have approached the termination stage; their status is as follows:

1. Robertson Pulp and Paper Laboratory, Raleigh, North Carolina, WPRD 115-01-68. A draft of the final report has been reviewed and returned to the grantee for rewrite.
2. Beet Sugar Development Foundation, Longmont, Colorado, WPRD 43-01-67. Two working days, with project personnel, were devoted to organizing the initial report draft. Not all field work had been completed. The final draft of this report is expected in the near future.
3. Georgia Kraft Company, Rome, Georgia, WPRD 117-01-68. The final draft report for this project has been received and returned to the grantee with corrections to be included in the final copy.

Areas of Concern

The program continues to suffer from a serious manpower shortage. Most effort continues to be expended on research grants and contracts. Very little resources are available to continue in-house research. It is questionable whether manpower will be available for the microsieve project to permit adequate PNWL field activity.

Budget restrictions will seriously curtail travel for this fiscal year. Present allowances will restrict both Pacific Northwest industry contacts and necessary administrative and technical participation in grant and contract activities in general.

Plans for the Second Quarter, FY 1970

1. Continue administrative and technical supervision of assigned grants and contracts.

2. Continue cooperative aspects of Lebanon project with Crown-Zellerbach Corporation.

3. Within budget limitations, embark on a field program employing the Beloit microsieve at local area mills and continue or enlarge on the sludge characterization studies in connection with aerated lagoon discharge.

FOOD WASTE RESEARCH BRANCH - 910101/1206

Status of Projects and Significant Accomplishments

The final report on secondary treatment of potato processing wastes is still being reproduced.

The 19th Potato Utilization Conference in Big Rapids, Michigan, was attended. Grant sites in Presque Isle, Maine, and Grand Forks, North Dakota were visited.

A meeting of National Canners Association personnel and pineapple processors from the Island of Oahu was attended. Discussions centered around pollution problems in the area of Honolulu resulting from activities of three pineapple processors.

An Engineering Committee (Idaho Potato Processors Association) meeting was attended. Results from last year's pilot plant work on secondary treatment of potato processing wastes were presented and plans for this year's work were discussed.

Program personnel participated in the dedication of The R. T. French Company waste treatment facility (Grant No. WPRD 15-01-67).

Following an extended acclimation period the two small-scale, laboratory anaerobic trickling filters were fed vegetable processing wastes. During July, unit number 1 was fed at a rate which resulted in an average detention time of 5.7 days; unit number 2 had an average of 7.4 days. COD reductions averaged 95 and 96 percent, respectively, and suspended solids were reduced by 81 and 88 percent, respectively

Two pilot plants were installed at the United Flav-R-Pac Cannery in Salem, Oregon, (the waste source for the laboratory anaerobic units). The first unit consists of a 32,000 gallon lagoon (diameter - 25 ft , depth = 9 ft.) that contains a 1 hp floating surface aerator and tube settlers. This pilot plant will be used to check the feasibility of using an aerated lagoon as an aerobic digester as well as an activated sludge system. No suspended solids will be wasted intentionally. Cannery waste following screening through 20 mesh screens is currently being fed at a 2 gpm rate. Both nitrogen and phosphorus are being added to maintain a COD:N:P ratio of approximately 100:5:1.

The second pilot plant system incorporates a Rotating Biological Contactor (RBC). The RBC was obtained following the termination of a research contract on treatment of combined sewer overflow. This system consists of a primary clarifier, the RBC "aeration unit," and secondary clarifier. Volume of the primary clarifier is 100 gallons and for the secondary, 150 gallons. The "aeration unit" is 14 inches deep, 18 inches wide, and 12 feet long. It contains 10 rows of 32 discs each. The discs are one foot in diameter and spaced at one-half inch center to center. Both the direction and speed of rotation of the discs can be controlled by valves and the hydraulic drive system. As the shafts are rotated about 50 percent submerged in the liquid, a microbial film absorbs and oxidizes dissolved organics and the rotation of the discs also aerates the liquid. This pilot plant will operate at various organic loads in parallel with the aerated lagoon facility.

Grants and Contracts

The following grant proposals and preproposals were received for review:

1. Investigation of Electroxidation as a Method of Reducing the Pollutional Load of Food Processing Liquid Wastes.
2. Ground Disposal Study.
3. Pilot Plant Installation for Use of Fungi Imperfecti on Vegetable Wastes.
4. Optimization of Bio-Chemical Waste Treatment Techniques.
5. Winery Wastewater-Characterization and Treatment.
6. Vermont Cheese Industry Pollution Abatement Project.
7. Elimination of Odors in Sugarbeet Transport Water Clarifier Systems.
8. Pollution Abatement and By-Product Recovery in Shellfish Processing.
9. Reduction of Salt Content of Food Processing Liquid Waste Effluent
10. Waste Treatment Facility at a Cheese Producer.
11. Pre-Treatment Industrial Waste from Poultry Processing Plant.
12. Process Upgrading and Utilization of Potato Solid Wastes as Fertilizer.
13. Biological Treatment of Wastes from Processing of Sweet Whey.
14. Combined Municipal/Industrial Waste Treatment Facility.

15. Treatment of Waste Sludges with Emphasis on Nutrient Enrichment.

During the quarter, the following grants were awarded:

1. Full-Scale Demonstration and Evaluation of Potato Dry and Wet Caustic Peeling Process, Western Potato Service, Inc. FWPCA Grant = $396,574. Total Project Cost = $1,148,331.
2. Pilot Plant Installation for Use of Fungi Imperfecti on Vegetable Wastes, Green Giant Company, LeSueur, Minnesota. FWPCA Grant = $49,742. Total Project Cost = $72,860.
3. Waste Treatment Facility, Kent Cheese Company, Melrose Park, Illinois. FWPCA Grant = $45,006. Total Project Cost = $65,722.
4. Development and Demonstration of an Ultrafiltration Plant for the Abatement of Pollution from Cottage Cheese Whey, Crowley's Milk Company, Inc., Binghamton, New York. FWPCA Grant = $495,856. Total Project Cost = $914,081.
5. Controlled Treatment of Combined Potato Processing - Municipal Waste by Anaerobic Fermentation, Aerobic Stabilization Process, City of Grand Forks, North Dakota. FWPCA Grant Supplement = $124,756.

These grants bring the total number to 33 in the Food Waste Research Branch in the assigned area of responsibility. They have a total estimated project cost of over $14,500,000 with FWPCA grant monies of $5,269,319.

Current status of grants which have been assigned a project officer in the Food Waste Research branch is as follows:

1. Cannery Waste Treatment by Lagoons and Oxidation Ditch, Melbourne Water Science Institute, Melbourne, Victoria, Australia. Although the second year's operation was started in April 1969, no progress reports have been received on this year's activities.

2. Aerobic Secondary Treatment of Potato Processing Wastes with Mechanical Aeration, the R. T. French Company, Shelley, Idaho. Construction of the full-scale facilities was completed and a formal dedication held on September 27, 1969. The system will be closely monitored throughout this processing season.

3. Pollution Prevention by Aeration of Fruit Processing Wastes, Snokist Growers, Yakima, Washington. A draft of the final report on this project has been reviewed and is currently being reworked prior to final approval for reproduction.

4. State of Art, Sugarbeet Processing Waste Treatment, Beet Sugar Development Foundation, Fort Collins, Colorado. The literature survey is still underway. A questionnaire was sent to each sugarbeet processor in the United States and a selected group of European processors. This will be followed up with site visits in selected instances to verify the information and fill in the voids.

5. Water Pollution Abatement in the United States Seafoods Industry: State of the Art, Oregon State University, Corvallis, Oregon. The literature review is approximately 50 percent complete. Nearly

two months were spent visiting seafood processors and related research organizations in Alaska, Washington, Oregon, California, Michigan, and Massachusetts.

6. Complete Aerobic Treatment of Combined Domestic and Industrial Wastes with Mechanical Aeration, City of Dallas, Oregon. Construction of the full-scale facilities has been completed and the testing program initiated.

7. Full-Scale Demonstration and Evaluation of Potato Dry and Wet Caustic Peeling Processes, Western Potato Service, Inc., Grand Forks, North Dakota. Equipment has been ordered for conversion of three full-scale peeling lines to "dry caustic" peeling. Sampling and analyses plans are currently being prepared.

8. Anaerobic-aerobic Sugar Beet Waste Treatment, Beet Sugar Development Foundation, Fort Collins, Colorado. As yet the first draft of the final report has not been completed. Grantee was given a 60-day extension for completion of this report.

9. Status and Research Needs for Potato Waste Waters, University of Washington, Seattle, Washington. The first draft of the final report is complete except for the section on Research Needs which will be completed shortly.

In addition to item 3 above, final report drafts have been reviewed on the following:

1. Treatment of Alkaline Wastes from Potato Processing, Vahlsing, Inc., Easton, Maine.

2. Cannery Waste Treatment by the Kehr Activated Sludge Process, FMC Corporation, Santa Clara, California.

3. Integrated Treatment of Liquid Wastes from Food Canning Operations, National Canners Association

Areas of Concern

The Branch continues to suffer as a result of borrowed positions and money. Grant monitoring has been less than minimal and the condition worsens as additional grants are awarded.

Plans for the Second Quarter, FY 1970

1. Continue grant monitoring and reviewing.
2. Continue pilot plant operation if money and manpower permits.

REGIONAL RESEARCH STUDIES - 910101/1208

Status of Projects and Significant Accomplishments

Aerated Lagoon Treatment of Food Processing Wastes

The final report is in the process of reproduction and should be available for distribution later in October.

Waste Treatment at Recreational Areas, Project No. 0970-208-11

A draft of the final report on Evaluation of Extended Aeration Treatment at Recreation Areas was reviewed and is being revised according to recommendations of the review committee.

Log Handling and Storage, Project No. 0970-208-12

Field work has been completed for this project. Analysis of biological data is proceeding as scheduled but will be hampered in the future because of personnel limitations. A shift of emphasis has required reduction of staff assigned to this project.

Animal Feedlot Waste Disposal, Project No. 0970-208-15

A project proposal is presently being drafted following extensive discussions with the State and Federal agencies concerned, as well as with individual feedlot operators, and the Idaho Cattlemen Feeders Association to determine the requirements of the study.

Areas of Concern

Limited funds and positions have been assigned to the Food Wastes and Paper and Allied Products Research areas, so these are being

strongly supported by the Regional Research Studies personnel. Budgetary restrictions have dictated reduction of temporary employees and elimination of all but most urgent expenditures for travel and equipment. Projects requiring travel or new equipment will be held in abeyance and new projects will be developed which can be accomplished without travel or new equipment. Also, publication of reports will be held to a minimum.

Reports and Papers

The final report of the Storm and Combined Sewer Contract 14-12-128 is in final preparation and a draft will be available in mid-October. Data are being evaluated and a report prepared on Pilot Plant Treatment of Steam Vat Condensates.

Plans for the Second Quarter, FY 1970

Waste Treatment at Recreation Areas, Project No. 0969-208-11

The final report will be revised and reviewed. It is planned to complete this project during the second quarter FY 70.

Log Handling and Storage, Project No 0969-208-12

Biological effects data will be evaluated.

Animal Feedlot Waste Disposal, Project No. 0970-208-15

The project proposal will be prepared and reviewed and study initiated to the extent permitted by budgetary limitations.

Other

Work will proceed on the Regional Status Report on Pesticides.

As existing projects are completed, new projects will be developed within limits imposed by existing personnel and budget.

BIOLOGICAL EFFECTS RESEARCH PROGRAM

Status of Projects and Significant Accomplishments

Thermal Pollution Studies

1. Tissue Enzyme Studies:

Research phases were deactivated as planned to allow the installation and testing of temperature and photoperiod controlling equipment, and the diversion of manpower to the adult salmon studies at Bonneville.

2. Simulation of Adult Sockeye Salmon Migration Through Elevated Temperatures:

Adult sockeye were collected from the fish trap at Bonneville Dam and 31 were acclimated to and held at $50^{o}F$, $62^{o}F$, $68^{o}F$ (legal maximum temperature) and $72^{o}F$. None of the fish survived $72^{o}F$ for longer than one week, or $68^{o}F$ for longer than three weeks.

Disease was the principal cause of death as affected by temperature, confinement, and pre-existing gas embolism (bubble disease) when these fish were removed from the supersaturated Columbia River. Antibody incidence and titer levels were determined on surviving fish, as were: (1) weight loss; (2) organosomatic indices for gonads and livers; (3) geriatrophy; and (4) other parameters. These data await further analysis.

A parallel study compared the suitability of using rainbow trout instead of adult salmon for these tests. The results demonstrate that rainbow trout could not be used as substitutes for adult sockeye salmon in these and perhaps other pollution-oriented tests.

3. Simulation of Adult Coho Salmon Migration Through Elevated Temperatures:

Because of disease problems described above, a crash program was completed to further modify the adult salmon testing facilities at Bonneville. This included expansion of the water supply, ultraviolet sterilization of recycle water, and modification of other features.

Adult coho were collected and assigned to the same temperature regime as used on adult sockeye. The experiment is proceeding according to plan.

A parallel study of adult coho passage time in the lower Columbia River and the concurrent weight loss at high river temperatures was conducted using hatchery return jack coho salmon. The study will be repeated at lower temperatures depending on the availability of funds, manpower, test fish, and river conditions.

Waste Treatment Studies

1. Determination of spatial requirements for natural spawning:

The spatial requirements for salmon spawning are being determined as a necessary requisite to the testing of pollution effects to salmon reproduction. Adult coho mating pairs are being held in various sized enclosures to determine the minimum space that allows natural spawning.

2. Effects of pollutants on salmon fertilization:

Plans, facilities, and materials for surveying the effects of industrial wastes on fertilization of salmon eggs have been

completed. Methanol has been selected as the reference toxicant and coho salmon will be the test species. Fertilization and incubation will be as before

3. Pesticide levels in adult Pacific salmon (West Coast):

Specimens have been collected, frozen, and shipped as requested by Dr. Howard Johnson, Michigan State University.

Areas of Concern

Highway Safety

The distance, frequency of travel, and subsequent fatigue from resulting labor at the Bonneville test site (144 miles one way) has produced several close calls on the highway. Considerable concern is hereby expressed for this situation.

Fail-Safe Protection

The Bonneville test site has relatively no fail-safe protection. As a result, any one of several problems could arise and cause the death of the fish, hence delay the completion of the experiment for one year. For example, a large bird (blue heron) struck the main power lines and caused a power outage for the second time this year (from 2:15 a.m. until 5:00 a.m.), but the extremely cold water contained sufficient oxygen to sustain the fish until power was resumed.

Although the current budget may not accommodate these needs, it is recommended that funds be expended for an alarm system and an

emergency power supply. Perhaps the best precaution would be to move the facility closer to the staff so that it can respond quickly to emergencies when they arise.

Plans for the Second Quarter, FY 1970

Thermal effects tests on adult coho salmon will be completed with their spawning and subsequent determinations of survival and gamete viability.

Levels of selected enzymes will be determined among various tissues of juvenile salmon that were held at various temperatures.

Fertilization of salmon eggs will be conducted in various industrial wastes to determine gametocidal properties.

CONSOLIDATED LABORATORY SERVICES PROGRAM

Status of Projects and Significant Accomplishments

The Pollution Surveillance sampling of streams for the purpose of determining the k rates for dissolved oxygen resources has been completed. A complete nitrogen balance was monitored in conjunction with dissolved oxygen depletion to differentiate between carbonaceous and nitrifying demand. A computer program to calculate the k, l, and H (developed by Gannon, University of Michigan) was used.

A significant inroad was made into the backlog of analyses by the end of the quarter.

Assistance was given to the Environmental Quality Control Commission, State of Oregon in the area of microbiological analyses. The state agency is monitoring the Willamette River to identify sources of microbiological inputs. Cooperation is continuing with the National Council for Stream Improvement on fecal coliform determination in paper pulping wastes.

All forms of nitrogen are being analyzed on samples shipped from Shagawa Lake. The samples are preserved with mercuric chloride on collection and shipped to Corvallis by airmail.

Automated Analytical System

Cadmium reduction of nitrate to nitrite is now used for determination of nitrate. This procedure has increased the sensitivity of the determination of nitrate. The reducing column lasts for

Areas of Concern

There is a long delay in acquiring parts for repair of equipment. Two gas chromatographs and a carbonaceous analyzer are not usable because of delays.

The main area of concern is the high turnover rate of temporary and intermittent employees. During this quarter we have lost five, well-trained people. Four of the five have been replaced and are undergoing training. Three of the four replacements have come to us with excellent education and training.

TRAINING AND MANPOWER DEVELOPMENT

910205/001

Direct Training

"Water Quality Surveys" training course was presented July 21-25, 1969, for 24 students.

"Freshwater Pollution Ecology" training course was presented September 15-19 for 23 students. Five applicants cancelled.

A staff member completed a reconnaissance trip to Alaska in preparation for future training courses to be held there.

Cooperative Area Manpower Planning System

The City of Portland subcontracted with the FWPCA for funds to train 40 waste treatment plant operators, effective September 22, 1969.

The Municipality of Metropolitan Seattle subcontracted with the FWPCA for funds to train 20 waste treatment plant operators, effective October 1, 1969.

Approximately 120 hours of teaching assistance and support were provided the Sewage Treatment Plant Operator training course at Linn-Benton Community College, Albany, Oregon.

Public Relations

Tours were provided for approximately 35 individuals during the quarter. Four hundred twenty five publications ("Showdown," "Needed, Clean Water," etc.) were provided elementary class teachers for use

in water pollution studies. Two films were loaned for viewing by 305 students of high school health classes.

Plans for the Second Quarter, FY 1970

"Basic Principles of Wastewater Treatment Operation," October 13-17, Anchorage.

"Basic Principles of Wastewater Treatment Operation," November 17-21, Corvallis.

One week of biology training and one week of membrane filter training will be provided U. S. Geological Survey employees from December 8-19, 1969.